EMITECH GROUPE

RRA-EMIESS23H879SER-02Av0

Radio test report

According to the standard:

CFR 47 FCC PART 15

Equipment under test:

S-LYNKS GATEWAY

FCC ID: *KQ9-0A01A*

Company:

SERCEL Inc

Distribution: Mr TIJOU **(Company:** SERCEL NANTES**)**

Number of pages: 17 with 1 appendix

Ed.	Date	Modified Page(s)	Technical Verification and Quality Approval Name and Function	Visa
0	15-Jan-24	Creation	M. DUMESNIL, Radio Laboratory Manager	

Information in italics are declared by the manufacturer/customer and are under his responsibility

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DESIGNATION OF PRODUCT:	***S-LYNKS GATEWAY***
Serial number (S/N):	*EDE565C20271E0004*
Reference / model (P/N):	*S-LYNKS GATEWAY*
Software version:	*SLBB_F V4 S38/20*
MANUFACTURER:	*SERCEL Inc*

COMPANY SUBMITTING THE PRODUCT:

Company:	SERCEL NANTES
Address:	16, RUE DU BEL AIR BP 30439 44470 CARQUEFOU FRANCE
Responsible:	Mr TIJOU
Person present during the tests:	Mr PORCHEL
DATES OF TEST:	19-Dec-23
TESTING LOCATION:	EMITECH ANGERS laboratory at JUIGNE SUR LOIRE (49) FRANCE FCC Accredited under US-EU MRA Designation Number: FR0009 Test Firm Registration Number: 873677
TESTED BY:	S. LOUIS **VISA:**
WRITTEN BY:	S. LOUIS

CONTENTS

REVISIONS HISTORY

Revision	Date	Modified pages	Modifications
0	**22-Dec-23**	/	Creation

1. INTRODUCTION

This report presents the results of radio test carried out on the following radio equipment ***S-LYNKS GATEWAY***, in accordance with normative reference.

The equipment under test integrates the followings radio functions:

- LoRa radio part not already certified,
- WiFi radio part not already certified,
- GNSS receiver.

This report is a justification statement for antenna as stated in 'Timco' newsletter for Part 15 applications with equipment classes DTS, DSS, NII, 6ID, etc. which require the antenna gain for compliance with EIRP limits.

2. PRODUCT DESCRIPTION

Class:	A
Utilization:	Industrial

LoRa radio part:

Antenna type and gain:	Integral antenna Gain at 903MHz => -1.32dBi Gain at 915MHz => -2.02dBi Gain at 927MHz => -0.42dBi
Operating frequency range:	From 902 MHz to 928 MHz
Number of channels:	41
Channel spacing:	600kHz
Modulation:	LoRa 500kHz
Power source:	Internal battery 7.2Vdc or 12Vdc external power source.

Power level adjusted to +18dBm by software

WiFi radio part:

Antenna type and gain:	integral antenna Antenna 1 Gain at 2412MHz => +4.70dBi Antenna 1 Gain at 2437MHz => +3.75dBi Antenna 1 Gain at 2462MHz => +3.48dBi Antenna 2 Gain at 2412MHz => +3.18dBi Antenna 2 Gain at 2437MHz => +3.17dBi Antenna 2 Gain at 2462MHz => +2.05dBi
Operating frequency range:	From 2400 MHz to 2483.5 MHz
Number of channels:	11
Channel spacing:	5MHz
Channel bandwidth:	20 MHz
Power setting	16 dBm
Modulation:	DBPSK OFDM: BPSK OFDM: 64-QAM
Mode tested:	802.11 b 802.11 g 802.11 n
Data rate:	For 802.11b: 1Mbit/s For 802.11g: 6Mbit/s For 802.11n: MCS0
Channel tested:	Channel 1: 2412 MHz Channel 6: 2437 MHz Channel 11: 2462 MHz
Correlated signal:	For mode n the signals are considered as correlated, the mode cyclic delay diversity (CDD) is used. (IEEE 802.11) The product is not using spatial multiplexing or intentional beamforming.
Power source:	Internal battery 7.2Vdc or 12Vdc external power source.

Power level, frequency range and channels characteristics are not user adjustable.
The details pictures of the product and the circuit boards are joined with this file.

3. NORMATIVE REFERENCE

The standards and testing methods related throughout this report are those listed below.
They are applied on the whole test report even though the extensions (version, date and amendment) are not repeated.

CFR 47 FCC Part 15 (2023)	Radio Frequency Devices
ANSI C63.10	2013 Procedures for ComplianceTesting of Unlicensed Wireless Devices.
558074 D01 DTS v05 r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.

4. TEST METHODOLOGY

Justification statement:
For antenna as stated in '**Timco**' newsletter for Part 15 applications with equipment classes DTS, which require the antenna gain for compliance with EIRP limits.

Radio performance tests procedures given in CFR 47 part 15:

Subpart C – Intentional Radiators
Paragraph 247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz

5. TEST EQUIPMENT CALIBRATION DATES

Emitech Number	Model	Type	Last calibration	Calibration interval (years)	Next calibration due
7566	Testo 608-H1	Meteo station	12/12/2022	2	11/12/2024
8549	Midwest Microwave 20dB	Attenuator	07/03/2022	3	06/03/2025
8896	ACQUISYS GPS8	Satellite synchronized frequency standard	/	/	/
9398	N-1.5m	cable	22/07/2022	2	21/07/2024
10759	COMTEST Cage 3	Anechoic chamber	/	/	/
10771	EMCO 3117	Antenna	30/11/2022	3	30/11/2025
10789	MATURO	Turntable and mat controller NCD	/	/	/
11592	R&S NRV-Z86	Power Sensor	19/07/2023	2	18/07/2025
12590	LUCIX Corp S005180M3201	Low-noise amplifier	21/06/2023	1	20/06/2024
14303	SUCOFLEX N-2m	cable	01/12/2022	2	30/11/2024
14831	Fluke 177	Multimeter	01/02/2022	2	01/02/2024
15666	R&S FSV40	Spectrum Analyzer	27/09/2022	2	26/09/2024
15883	SUCOFLEX	cable N 5m	08/02/2023	2	07/02/2025
15913	SUCOFLEX SF104 N 2.5m	Cable	01/12/2022	2	30/11/2024
///	R&S Power Viewer Plus V13.1	Software	/	/	/

6. TESTS RESULTS SUMMARY

6.1 CFR 47 part 15requirements

Test procedure	Description of test	Respected criteria?				Comment
		Yes	No	NAp	NAs	
FCC Part 15.247	OPERATION WITHIN THE BANDS 902-928 MHZ, 2400-2483.5 MHz and 5725-5850 MHz					
	(b) Maximum peak output power	X				Note 1
	(c) Operation with directional antenna gains > 6 dBi			X		

NAp: Not Applicable NAs: Not Asked

Note 1: First, for the LoRa function a measurement was performed using the radiated method, then a conducted measurement was performed with the same sample replacing the integral antenna by a SMA connector.

Gain antenna is calculated by subtracting conducted power measurement from radiated power measurement.

7. MEASUREMENT UNCERTAINTY

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s)

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%.

Parameter	Emitech Uncertainty
RF power, conducted	± 0.8dB
Radiated emission valid to 26 GHz 9kHz – 30MHz 30MHz – 1GHz 1GHz – 18GHz 18GHz – 40GHz	 ± 2.7. dB ± 5.0 dB ± 5.3 dB ± 6.1 dB
AC Power Lines conducted emissions	± 3.4 dB
Temperature	± 1 °C
Humidity	± 5 %

8. ANTENNA GAIN CALCULATION – LoRa RADIO PART

Temperature (°C) : 22 **Humidity (%HR):** 39 **Date :** December 19, 2023
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (b)
For RSS-247: paragraph 5.4

Radiated Method Measurement:
AVGSA-1 of paragraph 11.9.2.2.2 of ANSI C63.10

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in an open area test site (OATS), the EUT is placed on a rotating table, 0.8m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

Distance of antenna: 10 meters (in open area test site)

Antenna height: 1 to 4 meters (in open area test site)

Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measure of average output power is measured with a spectrum analyzer:

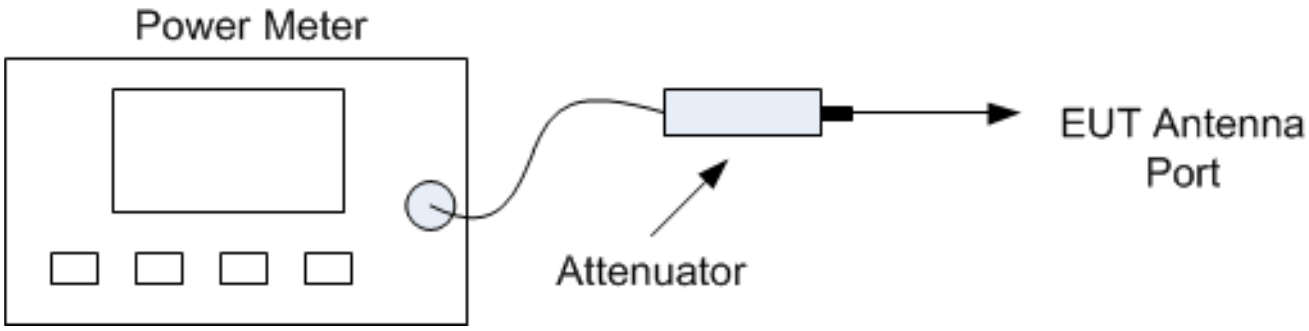
Resolution bandwidth:	1% to 5% of the OBW, not to exceed 1 MHz.
Video bandwidth:	3 x RBW
Span:	At least 1.5 x OBW
Detector:	RMS
Sweep points:	At least 2 x SPAN/RBW
Sweep time:	Auto
Trace:	Average detector RMS
Trace Number:	At least 100 traces

Then channel power function is used to compute power on OBW band.

Finally the radiated electro-magnetic field is converted in dBm with the following formula:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Conducted Method Measurement:
AVGPM method (using an RF average-reading power meter) of paragraph 11.9.2.3.1 of ANSI C63.10

Conducted test



The measure is realized in conducted mode with a calibrated average reading power meter.

Then, if necessary, the measure is adjusted with the duty cycle correction factor (10log(1/x) with x is the duty cycle).

Equipment under test operating condition:

The equipment is blocked in continuous modulated transmission mode by an internal data signal at the highest power level at which the transmitter is intended to operate.

P Software adjusted to +18dBm

We used for power source the internal 7.2Vdc Li-ion battery fully charged of the equipment.

Results:

Sample N° 1 Low Channel (F = 903 MHz)

	Radiated Output power measured at 10 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	100.3	15.53	16.85	-1.32

Polarization of test antenna: Vertical (height: 145 cm)
Position of equipment: Position 1 - (azimuth: 349 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 Central Channel (F = 915 MHz)

	Radiated Output power measured at 10 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	99.5	14.73	16.75	-2.02

Polarization of test antenna: Vertical (height: 140 cm)
Position of equipment: Position 1 - (azimuth: 0 degree)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 High Channel (F = 927 MHz)

	Radiated Output power measured at 10 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	101.0	16.23	16.65	-0.42

Polarization of test antenna: Vertical (height: 100 cm)
Position of equipment: Position 1 - (azimuth: 130 degrees)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

9. ANTENNA GAIN CALCULATION – WiFi RADIO PART

Temperature (°C) : 22 **Humidity (%HR):** 39 **Date :** December 19, 2023
Technician : S. LOUIS

Standard: FCC Part 15
RSS-247

Test procedure:
For FCC Part 15: paragraph 15.247 (b)
For RSS-247: paragraph 5.4

Radiated Method Measurement:
PKPM1 Peak power meter method of paragraph 11.9.1.3 of ANSI C63.10

First an exploratory radiated measurement was performed.

During this phase the product is oriented in these two normal positions.

Then the final measurement is realized with the product on the most critical orientation.

The system is tested in anechoic chamber, the EUT is placed on a rotating table, 1.5 m from a ground plane.

Zero degree azimuths correspond to the front of the device under test.

Distance of antenna: 3 meters

Antenna height: 1.5 meter

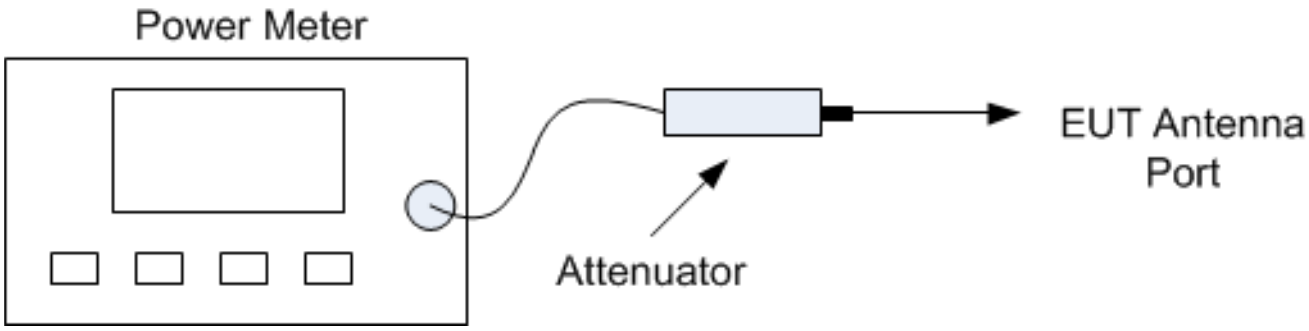
Antenna polarization: vertical and horizontal (only the highest level is recorded)

The measurement of the radiated electro-magnetic field is realized in radiated mode with a calibrated peak power reading power meter. (11.9.1.3 of ANSI C63.10).

Finally the radiated electro-magnetic field is converted in dBm with the following formula:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna with a Gain (unit in dBi) different following the frequencies used.

Conducted Method Measurement:
PKPM1 Peak power meter method of paragraph 11.9.1.3 of ANSI C63.10

Conducted test



The measure is realized in conducted mode with a calibrated peak power reading power meter.

The power sensor was used on each output port of the EUT. A power meter was used to read the response of the power sensor.

Equipment under test operating condition:

The equipment is blocked in continuous modulated transmission mode by an internal data signal at the highest power level at which the transmitter is intended to operate.

P Software adjusted to +16dBm

We used for power source the internal 7.2Vdc Li-ion battery fully charged of the equipment.

Results: RF1

Sample N° 1 RF1 - Low Channel (F = 2412 MHz)

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	118.79	23.56	18.86	4.70

Polarization of test antenna: Vertical (height: 150 cm)
Position of equipment: Position 2 (azimuth: 200 degrees for antenna 1 / 0 degree for antenna 2)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF1 - Central Channel (F = 2437 MHz)

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	118.38	23.15	19.40	3.75

Polarization of test antenna: Vertical (height: 150 cm)
Position of equipment: Position 2 (azimuth: 200 degrees for antenna 1 / 0 degree for antenna 2)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF1 - High Channel (F = 2462 MHz)

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	116.81	21.58	18.10	3.48

Polarization of test antenna: Vertical (height: 150 cm)
Position of equipment: Position 2 (azimuth: 200 degrees for antenna 1 / 0 degree for antenna 2)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Results: RF2

Sample N° 1 RF2 - Low Channel (F = 2412 MHz)

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	120.18	24.95	21.77	3.18

Polarization of test antenna: Vertical (height: 150 cm)
Position of equipment: Position 2 (azimuth: 200 degrees for antenna 1 / 0 degree for antenna 2)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF2 - Central Channel (F = 2437 MHz)

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	120.58	25.35	22.18	3.17

Polarization of test antenna: Vertical (height: 150 cm)
Position of equipment: Position 2 (azimuth: 200 degrees for antenna 1 / 0 degree for antenna 2)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

Sample N° 1 RF2 - High Channel (F = 2462 MHz)

	Radiated Output power measured at 3 meters (dBµV/m):	Conducted Output Power computed (1) (dBm)	Conducted Output Power measured (dBm)	Antenna Gain calculation (dBi)
Nominal supply voltage: 7.2Vdc	118.01	22.78	20.73	2.05

Polarization of test antenna: Vertical (height: 150 cm)
Position of equipment: Position 2 (azimuth: 200 degrees for antenna 1 / 0 degree for antenna 2)

(1) Conducted output power:
EIRP(dBm) = E (dBµV/m) + 20log(D) - 104.8; where D is the measurement distance in meters and antenna Gain = 0dBi (considered)

□□□ End of report, 1 appendix to be forwarded □□□

APPENDIX 1: Test equipment list

Antenna Gain Calculation

TYPE	MANUFACTURER	EMITECH NUMBER
Full anechoic chamber	EMITECH	10759
Turntable and mat controller NCD	MATURO	10789
Satellite synchronized frequency standard GPS8	ACQUISYS	8896
Spectrum Analyzer FSV40	Rohde & Schwarz	15666
Antenna 3117	ETS-Lindgren	10771
Low-noise amplifier S005180M3201	LUCIX Corp.	12590
N-1.5M Cable	SUCOFLEX	9398
N-2M Cable	SUCOFLEX	14303
N-5M Cable	SUCOFLEX	15883
N-2.5M Cable	H & S	15913
Attenuator 20dB	Midwest Microwave	8549
Power sensor NRV-Z86	Rohde & Schwarz	11592
Multimeter 177	Fluke	14831
Meteo station 608-H1	Testo	7566
Software	R&S Power Viewer Plus V13.1	///